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Forest Pest Management Report

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ANNUAL SOUTHWESTERN REGION
PEST CONDITIONS REPORT
1988

March 1989

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FOREWORD

This report presents the status of major insects and diseases on forested lands of all ownerships in the Southwestern Region during 1988. The information presented in this publication is based on aerial and ground surveys conducted by Forest Pest Management (FPM) Specialists, Southwestern Region, and State Pest Management Specialists of the Division of Forestry, Arizona State Land Department, and the New Mexico Department of Agriculture. These surveys report short-term changes in pest activity as well as indicating long-term trends when compared to previous surveys.

As in the past, FPM has compiled the information for lands of all ownerships; if required, further information and additional copies of this publication are available upon request.

Conditions in Brief

Bark beetle activity remained relatively unchanged from 1987 levels decreasing only slightly from 14,830 acres in 1987 to 13,235 acres in 1988. Total volume loss Regionwide was estimated to be 1,161,900 cubic feet. Within the ponderosa pine forest cover type, engraver beetle attacks resulted in the largest volume loss (612,150 cubic feet) followed by the western pine beetle (227,500 cubic feet) and the mountain pine beetle (83,250 cubic feet). In the mixed conifer and spruce forest cover types, tree mortality from Douglas-fir beetle, true fir beetles, and spruce beetle attacks resulted in 197,500, 36,000, and 5,500 cubic feet of volume loss, respectively.

Defoliation of mixed conifer Regionwide increased significantly from 289,220 acres in 1987 to 487,664 acres in 1988. Most of this defoliation (483,389 acres) was caused by the western spruce budworm. Some minor defoliation was also due to the New Mexico fir looper (2,600 acres) and white fir needle miner (1,675 acres).

Dwarf mistletoe surveys were done on 110,797 acres and control projects were done on a total of 3,566 acres of infected ponderosa pine.

Root and butt rots are another cause of wood volume loss in the Southwestern Region. Two root rotting agents are primarily responsible; Armillaria sp. and Heterobasidion annosum. Damage from Armillaria sp. infestation occurs primarily in ponderosa pine stands, while damage from H. annosum infestation occurs primarily in mixed conifer and spruce fir cover types. Estimates of volume loss have not been determined.

Status of Major Insect Pests

Engraver beetles, Ips spp. Engraver beetle activity increased slightly Regionwide from 3,020 acres in 1987 to 4,985 acres in 1988. Over 58 percent of the ponderosa pine mortality attributed to these beetles in 1988 occurred on three Districts of the Lincoln National Forest; the Smokey Bear (2300 acres), Cloudcroft (450 acres), and Mayhill (175 acres) Ranger Districts. The cause of this outbreak was unknown. Ips-caused tree mortality on the Apache-Sitgreaves (45 acres), Coconino (40 acres), Kaibab (100 acres), and Tonto (20 acres) National Forests; and the Fort Apache (425 acres), San Carlos (165 acres), and Navajo (10 acres) Indian Reservations, AZ; and the Carson (500 acres), Cibola (25 acres) and Santa Fe (30 acres) National Forests; and the Mescalero Apache (300 acres), and Santa Clara (400 acres) Indian Reservations, NM, consisted of widely scattered single and small group (less than 10 trees) tree mortality. Ips beetle-caused tree mortality on state and private ownerships in Arizona and New Mexico was also of minor significance consisting of mainly individual and small group tree mortality. Estimated volume losses caused by these insects approximated 612,150 cubic feet.

Western pine beetle, Dendroctonus brevicomis. Area of western pine beetle-caused ponderosa pine mortality increased approximately, eight-fold, from 325 acres in 1987 to 2,590 acres in 1988. Substantial increases in western pine beetle-caused tree mortality occurred on the Bradshaw (115 acres) Ranger District, Prescott National Forest; Payson (100 acres), Pleasant Valley (450 acres), and Globe (175 acres) Ranger Districts, Tonto National Forest; and the Fort Apache (150 acres) Indian Reservation, AZ; and the Cloudcroft (900 acres) and Mayhill (175 acres) Ranger Districts, Lincoln National Forest; and Mescalero-Apache (225 acres) Indian Reservation, NM. Western pine beetle infestations on the Prescott and Tonto National Forests generally occurred in association with Ips beetles. Elsewhere throughout the Region on the Apache-Sitgreaves (120 acres), Coconino (10 acres), Coronado (50 acres), and Kaibab (95 acres) National Forests, AZ; and the Gila (25 acres) National Forest, NM, western pine beetle-caused tree mortality was insignificant, consisting of widely scattered single and small group (less than 10 trees) tree mortality. Volume losses resulting from these bark beetles were estimated at 227,500 cubic feet.

Mountain pine beetle, Dendroctonus ponderosae. The mountain pine beetle continued to cause low levels of ponderosa pine mortality throughout the Southwest in 1988. Estimated area of tree mortality Regionwide increased slightly from 1,190 acres in 1987 to about 1,555 acres in 1988. Again, the majority of this mortality occurred on the Grand Canyon (600 acres) National Park, AZ; and the Camino Real (250 acres) Ranger District, Carson National Forest; and Taos Pueblo (635 acres) Indian Reservation, NM. Some individual and small group (less than 10 fading trees) tree mortality also occurred on the Navajo (20 acres) Indian Reservation, AZ; and the Santa Fe (50 acres) National Forest, NM. In addition, pockets of up to 15 mountain pine beetle-killed trees were also detected in the Moreno Valley, Colfax County, NM. Volume losses resulting from these bark beetles were estimated at 83,250 cubic feet Regionwide.

Spruce beetle, Dendroctonus rufipennis. In 1988, spruce beetle infestations declined to their lowest levels in seven years. Area of spruce beetle activity decreased significantly from 1,238 acres in 1987 to 55 acres in 1988. Spruce mortality, which consisted of individual and some small group (less than 10 fading trees) tree mortality, occurred on the Alpine (5 acres) Ranger District, Apache-Sitgreaves National Forests, AZ; and Canjilon (50 acres) Ranger District, Carson National Forest, NM. Estimated volume losses caused by the spruce beetles in 1988 approximated 5,500 cubic feet.

Western spruce budworm, Choristoneura occidentalis. The western spruce budworm continued to cause substantial amounts of defoliation throughout the mixed conifer forest cover type in 1988. Area of aerially detectable defoliation increased nearly two-fold from 265,900 acres in 1987 to 483,400 acres in 1988 (Table 1). The largest areas of contiguous defoliation continued to occur on the Carson (185,660 acres) and and Santa Fe (218,320 acres) National Forests in northern New mexico. Less extensive areas of

defoliation were detected on the Apache-Sitgreaves (5,840 acres) National Forests, and Navajo (2,450 acres) Indian Reservation, AZ; and the Cibola (7,700 acres), Gila (1,640 acres), and Lincoln (11,830 acres) National Forests, and Jemez (3,000 acres), Jicarilla (1,730 acres), Picuris (820 acres), and Santa Clara (3,160 acres) Indian Reservations, NM. Light defoliation was observed in the Kachina Peaks Wilderness, Coconino National Forest, and portions of the Kaibab National Forest, AZ. Approximately 41,239 acres of private lands were also defoliated in 1988. Most of this defoliation occurred in northern New Mexico in Rio Arriba and Santa Fe Counties.

Volume losses resulting from continous budworm deliation were estimated at 3.4 million cubic feet. Typical feeding damages caused by insect are shown in Figure 3.

Table 1--Acres of western spruce budworm defoliation by ownership and intensity of defoliation, Southwestern Region, 1988.

Land Ownership Class	Relative Defoliation (acres) Light	Moderate	Heavy	Total
National Forest	200,140	202,350	28,500	430,990
Other Federal[1]	3,890	5,590	1,680	11,160
Private	27,457	13,782	0	41,239
Total	231,487	221,722	30,180	483,389

[1] Includes lands administered by the National Park Service, Bureau of Indian Affairs, Bureau of Land Management, and Department of Defense.

Budworm infested areas treated on the Lincoln National Forest and Mescalero Apache Indian Reservation in 1984 continued to show no significant defoliation. However, new areas of light defoliation were observed for the first time just south of the 1984 treatment area near Carriza Lookout on the Mayhill Ranger District. This may indicate a building population and potential reinfestation of treatment areas in the near future.

Pandora moth, Coloradia pandora. In 1987, larvae of the pandora moth defoliated approximately 720 acres of ponderosa pine on the Grand Canyon National Park, AZ. Because this insect has a two year life cycle, defoliation is not expected to occur on the Park again until 1989. In Prescott, AZ, however, where this moth appears to have a one year life cycle, some minor defoliation damages occurred on ornamental ponderosa pines at intermingled state and private residences.

Status of Pest Complexes

Aspen defoliators. This complex includes the large aspen tortrix, Choristoneura conflictana; western tent caterpillar, Malacosoma californicum; Marssonina leaf spot, Marssonina populi; and ink spot disease, Ciborinia whetzelii. Regionwide, defoliation of aspen by this insect and disease complex more than doubled from 24,280 acres in 1987 to 67,775 acres in 1988. Ground examinations made at several locations throughout the Region by Forest Pest Management Specialists revealed that the vast majority of this defoliation detected in 1988 was disease related. Although some evidence of aspen tortrix defoliation

was observed at several locations throughout the Region, defoliation by this insect was generally considered minor and insignificant in 1988. The most extensive areas of aspen defoliation this year occurred on the Apache-Sitgreaves (3,600 acres), Coconino (1,775 acres), and Kaibab (2,7225 acres) National Forests, Grand Canyon (8,550 acres) National Park; and Fort Apache (10,150 acres), Navajo (2,950 acres), and San Carlos (150 acres) Indian Reservations, AZ; and the Carson (6,020 acres), Gila (620 acres), and Santa Fe (3,650 acres) National Forests; and the Jicarilla Apache (120 acres), and Taos Pueblo (160 acres), Indian Reservations, NM. This insect and disease complex also defoliated approximately 2,700 acres of aspen on state and private holdings in northern New Mexico.

Douglas-fir mortality. Douglas-fir beetle-caused tree mortality decreased slightly in area from 5,020 acres in 1987 to 3,360 acres in 1988. As in 1987, the majority of this tree mortality occurred on the Carson (2,780 acres) National Forest and adjacent lands of private ownership, and Taos Pueblo (420 acres) Indian Reservation in northern New Mexico. Some minor individual and small group (less than 10 trees) tree mortality also occurred on the Apache-Sitgreaves (15 acres) National Forests; and Fort Apache (15 acres) and Navajo (100 acres) Indian Reservations, AZ; and the Santa Fe (30 acres) National Forest, NM. Although the Douglas-fir beetle, Dendroctonus pseudotsugae, caused most of the mortality observed in the Region, almost all of the trees killed in 1988 were predisposed to attack by: (1) Severe stress from past western spruce budworm defoliation, (2) dwarf mistletoe infections, (3) root diseases, and (4) poor site conditions. Once these bark beetle infestations increase to epidemic proportions, there is little that can be done to stem the outbreak. Extensive areas of tree mortality resulting from these outbreaks (Figures 1 & 2) often become a sensitive "issue" particularly where private and Forest Service lands interface. Current years volume loss caused by this pest complex in 1988 was estimated at 197,500 cubic feet.

Figure 1. Douglas-fir beetle-killed trees on National Forest lands adjacent to private ownerships.

Figure 2. Douglas-fir beetle larval feeding galleries.

True fir mortality. True fir mortality caused by the fir engraver beetle, Scolytus ventralis, the primary bark beetle attacking white fir; the western balsam bark beetle, Dryocetes confusus, commonly found attacking cork bark fir; and associated root diseases decreased two-fold in area Regionwide from 1,266 acres in 1987 to 690 acres in 1988. Individual and small group (less than 10 trees) tree mortality in 1988 occurred on the Apache-Sitgreaves (5 acres), Coconino (40 acres), Coronado (25 acres), and Prescott (10 acres) National Forests; Fort Apache (200 acres), and Navajo (100 Acres) Indian Reservations; and adjacent private (100 acres) ownerships, AZ; and the Carson (95 acres), Gila (5 acres), Lincoln (20 acres), and Santa Fe (60 acres) National Forests; and Taos Pueblo (30 acres) Indian Reservation, NM. Estimated volume losses caused from this insect and disease complex approximated 36,000 cubic feet.

Status of Other Insects in the Southwest, 1988

Insect	Host	Location	Remarks
Pinyon needle scale *Matsucoccus acalyptus*	Pinyon pine	Arizona New Mexico	Some minor infestations of these insects occurred on ornamental pines in Prescott, Arizona. In New Mexico infestations totaling 350 acres were detected on private lands in and around El Rito and Willard.
Prescott scale *Matsucoccus vexillorum*	Ponderosa pine	Arizona	Prescott scale infestations caused minor amounts of twig and branch die back to seedlings, saplings, and pole-sized ponderosa pines on the Chevelon Ranger District, Apache-Sitgreaves National Forests. These insects also caused some minor tree damages on ornamental pines in Clints Well, Heber, Overgaard, and Prescott.
Spruce aphids *Elatobium* sp.	Spruce	Arizona	Caused approximately 100 acres of moderate to heavy defoliation on the Fort Apache Indian Reservation.
Twig beetles *Pityophthorus* spp.	Ponderosa pine Pinyon pine	New Mexico	Twig beetles caused considerable twig and branch die-back on ornamental ponderosa and pinyon pines on private ownerships throughout New Mexico.
Douglas-fir tussock moth *Orgyia pseudotsugata*	Douglas-fir White fir Spruce	New Mexico	Tussock moth infestations on ornamental Douglas-fir, white-fir, and spruce increased noticeably in Los Alamos, Santa Fe, and White Rock.
New Mexico fir looper *Galenara consimilis*	Douglas-fir White fir	New Mexico	This insect, in combination with abiotic factors, caused light to moderate defoliation to approximately 2,600 acres of mixed conifer cover type stressed from winter drying on the Lincoln National Forest.
Pine needle sheath miner *Zelleria haimbachi*	Ponderosa pine	Arizona	These insects damaged new growth on ponderosa pine in east Flagstaff. Many of the needle sheath miner-infested trees were also attacked by needle miners and sawflies.
Pine tip moth *Rhyacionia* spp.	Ponderosa pine	Arizona New Mexico	Tip moths caused significant damage to new growth on ornamental ponderosa pine seedlings and saplings in many urban locales of Arizona and New Mexico.

Status of Other Insects in the Southwest, 1988

Insect	Host	Location	Remarks
Pinyon needle miner *Coleotechnites edulicola*	Pinyon pine	New Mexico	The pinyon needle miner defoliated approximately 3,000 acres of pinyon on state and private lands near Santa Fe and Tres Piedras. Although some twig and limb die-back and tree mortality has already occurred, the majority of the trees appear to be recovering.
White fir needle miner *Epinotia meritana*	White fir	Arizona	Continued to cause minor defoliation on northern half of the Kaibab National Forest for the second consecutive year. Approximately 1,675 acres were defoliated in 1988, in 1987 1,120 acres were defoliated.
Pine sawfly *Diprion* spp.	Ponderosa pine	Arizona	These insects caused light defoliation on ornamental pines along I-40 in east Flagstaff.

STATUS OF DISEASES

Dwarf mistletoes. The dwarf mistletoes, Arceuthobium spp.; are the most damaging agents of commercial timber throughout the Southwest. Over 2.2 of the 4.8 million total acres of commercial National Forest land are currently infested. Estimates of annual growth loss range from 100 to 150 million board feet for Arizona and New Mexico. Three principle hosts and dwarf mistletoe species are involved: Ponderosa pine, A. vaginatum subsp. cryptopodum; spruce, A. microcarpum; and Douglas-fir, A. douglasii. A. vaginatum is responsible for the greatest losses.

Presuppression surveys, funded by FPM were conducted in 1988 on 61,397 acres of infested ponderosa pine stands on a total of nine Ranger Districts in six National Forests. An additional 49,400 acres of dwarf mistletoe infested ponderosa pine and mixed conifer type were surveyed on BIA trust lands. Data on the incidence and severity of mistletoe was obtained in the stands surveyed. This information, along with the growth and yield program RMYLD2, aided in the evaluation and selection of silvicultural prescriptions for the stands.

The Regionwide mistletoe survey continued in 1988 to encompass the Tonto and Coronado National Forests. Information pertaining to distribution, severity, and volume losses associated with A. vaginatum now available for all National Forests in the Region (see Recent Publications).

Stem cankers and decay. Aspen stands in Arizona and New Mexico are attacked by a number of stem cankering fungi including: Ceratocystis fimbriata, Hypoxylon mammatum, Encoelia pruinosa (Cenangium singulare), Cytospora chrysosperma, and Cryptosphaeria populina. Canker fungi cause significant reductions in growth and vigor in mature aspen stands, as a result of tree mortality, top breakage, cull, and degrading. In many of the Region's aspen stands, 30 percent or more of the stems are affected. In addition, aspen timber type suffers widespread losses to stem decay caused by the false tinder fungus, Phellinus tremulae. White trunk rot incidence is especially significant in mature aspen stands, and cull volumes may range as high as 50 to 60 percent of the total standing volume. As the aspen resource is developed in this Region, and aspen stands are more routinely subjected to timber management planning and commercial entries, it will be necessary to critically evaluate the impact of these diseases and develop management strategies for their control.

Root diseases. Root and butt rot pathogens are responsible for approximately 10-percent reduction in yield Regionwide. Armillaria spp. accounts for most of the wood volume loss in conifers, especially ponderosa pine. Other root pathogens, including Heterobasidion annosum, Phaeolus scheinitzii, and Inonotus tomentosus, are responsible for the remaining loss. Annual losses due to mortality from root rots range from 15-20 MMBF. If growth losses are included, loss estimates run as high as 45 MMBF.

Foliage diseases. The occurrence of Lophodermella needle cast (Lophodermella cerina) in ponderosa pine increased slightly this year. In addition to the Lincoln National Forest and the Mescalero Indian Reservation, the Cibola National Forest (1,450 acres of ponderosa pine) was also affected. Approximately 4,040 and 1,300 acres of ponderosa pine were infested on the

Lincoln National Forest in 1987 and 1988, respectively. A total of 14,960 and 18,700 acres of infested ponderosa pine were detected on the Mescalero Indian Reservation in 1987 and 1988, respectively.

Marssonina blight (Marssonina populi) was widespread throughout the Region in 1988. A total of 65,075 acres of infested aspen were detected.

Figure 3. Aspen leaves infected with Marssonina leaf spot disease, Marssonina populi.

Nursery diseases. Seedbed fumigation with methyl bromide and cloropicrin continued to be evaluated at the Albuquerque Tree Nursery. Pre- and post fumigation surveys indicated that fumigation still effectively reduced the levels of Fusarium spp. in the soil, with a resultant increase in seedling survival.

Disease	Host	Location	Remarks
STEM AND BRANCH DISEASES			
Aspen trunk rot *Phellinus tremulae*	Aspen	Arizona, New Mexico	*Phellinus tremulae* was responsible for the most common cull and defect in aspen. This white trunk rot, widespread throughout the host type, caused significant losses, especially in mature stands. Cull volumes may equal as much as 60 percent of the total volume.
Comandra blister rust *Cronartium comandrae*	Mondell pine, ponderosa pine	Arizona	Comandra blister rust occurred in the Payson and Prescott areas on exotic Mondell and the native ponderosa pines. Damage has been restricted to individual trees but the possibility exists that the disease may spread to nearby Christmas tree plantations.
Dwarf mistletoes *Arceuthobium* spp.	Douglas-fir, Engelmann spruce, ponderosa pine	Arizona, New Mexico	Dwarf mistletoe infestation caused a significant decrease in yield on commercial and noncommercial Forest lands. Approximately 46 percent (2.2 million acres) of the total commercial acreage (4.8 million acres) was infested; losses in wood production may exceed 25 million cubic feet of commercial timber in Arizona and New Mexico. As a point of reference, the estimated total volume from commercial conifers is approximately 202 million cubic feet.
Fir broom rust *Melampsorella caryophyllacearum*	True firs	Arizona, New Mexico	Fir broom rust was widely distributed in subalpine, corkbark, and white firs and caused occasional top breakage. The impact of the disease appears to be unusually high on Sandia Peak, Cibola National Forest, NM. There, bole cankers and associated breakage is wide-spread and infected trees are experiencing moderate mortality.

Disease	Host	Location	Remarks
Red ring rot *Phellinus pini*	Douglas-fir, ponderosa pine, spruce, true firs	Arizona, New Mexico	*Phellinus pini* is indigenous to mature and overmature stands of pine and mixed conifers. Scattered in distribution, losses and damage were minimal in most stands. It has also been found on immature pine and mixed conifers in suppressed conditions.
Rust-red stringy rot *Echinodontium tinctorium*	Spruce, true firs	Arizona, New Mexico	This fungus was scattered in mature and overmature stands of mixed conifers but caused insignificant losses.
Spruce broom rust *Chrysomyxa arctostaphyli*	Spruce	Arizona, New Mexico	Spruce broom rust was scattered throughout the host type but was of little commercial significance.
Stem cankers *Encoelia pruinosa* *Ceratocystis fimbriata* *Cryptosphaeria populina* *Hypoxylon mammatum*	Aspen	Arizona, New Mexico	Canker fungi caused significant reductions in the yield of mature aspen stands. Damage included tree mortality from girdling cankers, top breakage, cull, and decay. Many stands have over 30 percent infection with one or more of these stem canker fungi.

Disease	Host	Location	Remarks
ROOT DISEASES			
Annosus root disease *Heterobasidion annosum*	Douglas-fir, ponderosa pine, spruce, true firs	Arizona, New Mexico	In Arizona and New Mexico, root and butt rot pathogens were responsible for an approximate 10 percent reduction in yield of infested stands. Losses may be as high as 25 percent in some seriously infested stands. *Armillaria* spp. accounted for 80 percent of the root disease damage in conifers; other root pathogens were responsible for the remaining 20 percent. The Southwest loses an estimated 4.8 million cubic feet annually to root rot.
Armillaria root disease *Armillaria* spp.	Douglas-fir, ponderosa pine, true firs	Arizona, New Mexico	
Schweinitzii butt rot *Phaeolus schweinitzii*	Douglas-fir, true firs	Arizona, New Mexico	
Tomentosus root rot *Inonotus tomentosus*	Ponderosa pine, spruce	Arizona, New Mexico	
Black stain root disease *Ceratocystis wageneri* [*Verticicladiella wageneri*]	Pinyon pine, ponderosa pine	Arizona, New Mexico	Black stain root disease was scattered throughout the Southwest. Losses were insignificant in commercial timber.
Ganoderma applanatum	Aspen	Arizona, New Mexico	Scattered throughout the host type, the fungus caused windthrow and standing cull.
FOLIAGE DISEASES			
Elytroderma disease *Elytroderma deformans*	Pinyon pine, ponderosa pine	Arizona, New Mexico	Elytroderma disease was widely distributed but at low levels.
Marssonina leaf spot *Marssonina populi*	Aspen	New Mexico Arizona	This disease increased noticeably in 1988. Approximately 65,075 acres of infested aspen were detected. A total of 42,895 of these acres were located on the Apache-Sitgreaves, Carson, Coconino, Gila, Kaibab, and Santa Fe National Forests. Approximately 22,080 acres of aspen were infested on other Federal lands including the: San Carlos, Ft. Apache, and Navajo Indian Reservations; the remaining 100 acres were on private lands.

Disease	Host	Location	Remarks
Lophodermella needle cast *Lophodermella cerina*	Ponderosa pine	Arizona, New Mexico	Ponderosa pine of all ages were infected with this needle cast on the Cibola (1,450 acres), and Lincoln (1,300 acres) National Forests as well as the Mescalero Indian Reservation (18,700 acres).
White pine needle cast *Hypodermella arcuata*	SW White pine	Arizona	Many of the SW white pines along Schultz Creek, Coconino National Forest were infected with this fungus. Infections occurred during the spring of 1987 and resulted in dieback of one-year-old needles this year.
ABIOTIC			
Frost Damage	White fir	Arizona	Scattered dieback of newly expanding shoots caused by late spring frost was observed on the Coconino and Kaibab National Forests.
Winter drying	Ponderosa pine	Arizona	Ponderosa pine of all size classes exhibited tip dieback of one-year-old needles along a band on O'Leary Peak, Coconino National Forest. Winter drying results from desiccation of needles following transpiration without replacement of water due to cold or frozen roots.

FOREST PEST MANAGEMENT ACTIVITIES IN 1988

Major activities of the Southwestern Region FPM Staff include detection, evaluation, and suppression of forest pests and technical assistance to forest land managers on all Federal lands in Arizona and New Mexico. In addition, FPM personnel cooperated with the States of Arizona and New Mexico in carrying out forest pest management activities on State and private lands through the Cooperative Forest Pest Action Program.

Detection Surveys

Detecting and monitoring insect and disease outbreaks and infestations is a major responsibility of the FPM Staff. This is accomplished by systematic aerial surveys, ground examinations, and encouraging forest workers to report unusual and suspected insect and disease occurrences by means of field surveillance kits provided by FPM.

Aerial surveys were conducted from July through August over 9.4 million acres of coniferous forests in Arizona and New Mexico to determine the location and extent of damage caused by insects and/or diseases. Upon completion of the surveys, maps showing the location, relative intensity, and kinds of outbreaks were prepared and sent to the respective administrative units.

Ground examinations were made, when necessary, to confirm aerial detection observations, as well as in response to requests from land managers for detailed information or identification. State pest management specialists conducted ground surveys on State and private lands in Arizona and New Mexico.

A wide variety of insects and diseases were identified by the staff from surveillance reports sent by forest workers from across the Region (Tables 2 and 3). Such reports are important for the early detection of potential pest problems, and land managers and forest workers are encouraged to continue to be alert for, and prompt in reporting, any unusual insect and disease activity.

Evaluations

Another major responsibility of FPM is to conduct biological evaluations of forest insect and disease pests and provide land managers with alternatives and recommendations for management through a variety of approaches. In 1988, FPM conducted the following biological evaluations:

A. Entomology

(1) Western spruce budworm egg mass surveys, Apache-Sitgreaves National Forest, AZ, and the Carson, Gila, and Santa Fe National Forest, NM; (2) western spruce budworm presuppression larval survey, Carson National Forest, NM; (3) Ips outbreak potential in winter storm damaged areas; (4) winter damage and fir looper evaluation, Lincoln National Forest, NM; (5) pandora moth evaluation, Grand Canyon National Park, AZ; and (6) evaluation of tree mortality in the Indian Timber Sale, Bradshaw Ranger District, Prescott National Forest, AZ.

B. Pathology

(1) Biological evaluation of the Luna Plantation Dwarf Mistletoe Control Project (3-89-06), Luna Ranger District, Gila National Forest; (2) Bear Springs Dwarf Mistletoe Suppression Project, Southern Pueblos Agency, New Mexico; (3) Apache Summit Dwarf Mistletoe Suppression Project, Mescalero-Apache Indian Reservation, New Mexico; (3) biological evaluation of the May Dwarf Mistletoe Control Project (3-89-2), Williams Ranger District, Kaibab National Forest, Arizona; (4) Albuquerque Tree Nursery biological evaluation (R3 89-1), Cibola National Forest, New Mexico; (5) biological evaluation of the Puck Jr. Dwarf Mistletoe Control Project (3-89-13), Flagstaff Ranger District, Coconino National Forest, Arizona; (6)

biological evaluation of the Pine Creek Mistletoe Control Project (3-90-3), Chino Valley Ranger District, Prescott National Forest; (7) biological evaluation of the Cherry/Meads Dwarf Mistletoe Control Project (3-89-8), Payson and Pleasant Valley Ranger Districts, Tonto National Forest; (8) post-suppression evaluation of the Benji dwarf mistletoe control project, El Rito Ranger District, Carson National Forest, New Mexico.

Suppression projects

Forest insect and disease pests occasionally increase to significant levels and cause unacceptable damages to Forest resources. These pests must then be managed by employing a combination of silvicultural, mechanical, biological, and/or chemical suppression strategies.

In 1988, FPM funded insect control projects in both Arizona and New Mexico. These control projects consisted of: (1) The removal of Ips bark beetle susceptible storm damaged ponderosa pines in and near recreation sites on the Payson and Pleasant Valley Ranger Districts, Tonto National Forest, AZ, and (2) the suppression of western spruce budworm larval populations in 14 campgrounds on the Camino Real Ranger District, Carson National Forest, NM. These campgrounds were treated with ground based applications of *Bacillus thuringiensis* at 16 BIU's (Billion International Units) per acre.

In addition to the above projects, FPM also funded the following dwarf mistletoe projects: Thinning, killing, or removing infested trees to control dwarf mistletoe infestations on a total of 552 acres of National Forest and 3,014 acres of BIA trust lands as listed in Table 4:

Table 4--Dwarf mistletoe presuppression surveys and suppression projects conducted during 1988 on National Forest and BIA trust lands.

National Forest	Ranger District	Acres	Survey	Suppression
Apache-Sitgreaves	Alpine	24,720	X	
Cibola	Mt. Taylor	540	X	
	Mt. Taylor	60		X
Carson	Camino Real	1,481	X	
	Questa	1,500	X	
Gila	Luna	4,500	X	
	Reserve	492[1]		X
	Reserve	1,054	X	
Santa Fe	Cuba	5,602	X	
Tonto	Payson	12,000	X	
	Payson/Pleasant Valley	10,000	X	

Area Office	Agency	Acres	Survey	Suppression
Albuquerque	Mescalero	994		X
	Mescalero	2,500	X	
	Jicarilla	243		X
	Jicarilla	31,006	X	
	Northern Pueblos	120		X
	Southern Pueblos	3,300	X	
	Southern Pueblos	469		X
	Laguna	45		X
	Zuni	38		X
Phoenix	Fort Apache	1,105		X
	Fort Apache	1,129	X	
	San Carlos	11,465	X	

[1] Three year project

Testing of New Technology. It is also the responsibility of FPM to assist in the development and testing of new pest control technology. The effectiveness of various concentrations of ethephon sprays on dwarf mistletoe infected trees is currently being tested. When applied as a topical spray this material causes shoot abscission, and thus prevents spread of the mistletoe.

Tests were made on Southwestern dwarf mistletoe (Arceuthobium vaginatum subsp. cryptopodum) at the Los Alamos National Laboratory (LANL), near Santa Fe, New Mexico. Two concentrations of ethephon (1,200 ppm and 2,500 ppm) were sprayed on two test blocks of twenty five trees each. A control block of twenty-five trees were sprayed with water only. Application of ethophon was successful in causing shoot abscission at both concentrations, but 2,500 ppm caused greater level of shoot abscission (92% abscission) than 1,200 ppm (72% abscission). Very little abscission occurred in the control blocks (8% abscission).

RECENT PUBLICATIONS

Maffei, Helen M., Jerome S. Beatty. 1989. Incidence, severity, and growth losses associated with ponderosa pine dwarf mistletoe on the Tonto and Coronado National Forests, Arizona. R-3 89-1. 33p.

Tkacz, Borys M. 1989. Incorporating pest management into land management decisions. In Proceedings of Western International Forest Disease Work Conference.